WHAT IS CLAIMED IS:

1. An antenna system comprising:

a first fractal antenna having an element that is defined substantially as a deterministic fractal of iteration $N \geq 2$ for at least a portion of said element, said first antenna being characterized in space by at least one resonant frequency and by a bandwidth; and

a conductive element, spaced-apart from said first fractal antenna by a distance Δ sufficiently small at a frequency of interest λ to decrease said at least one resonant frequency, to widen said bandwidth, or to cause a combination thereof.

2. The antenna system of claim 1, wherein said Δ has at least one characteristic selected from the group consisting of (a) said first fractal antenna and said conductive element are spaced-apart in different planes by a distance $\Delta \leq 0.05\lambda$, (b) said first fractal antenna and said conductive element are spaced-apart in a common plane by said distance Δ, and (c) at least one of said first fractal antenna and said conductive element is non-planar and said distance Δ defines a closest distance separating said first fractal antenna from said conductive element.

3. The antenna system of claim 1, wherein said conductive element is selected from the group consisting of (a) a planar conductor, (b) a second fractal antenna having a same said iteration N as said first fractal antenna, (c) a second fractal antenna having a same said iteration N as said first fractal antenna but having a different configuration, (d) a second fractal antenna having an iteration other than said iteration N, and (e) a second fractal antenna having an iteration other than said iteration N, but having a similar configuration.

4. The antenna system of claim 1, wherein said conductive element is a second fractal antenna that is rotated through a relative angle θ with respect to said first fractal antenna, wherein said rotation alters at least one characteristic of said antenna system.

5. The antenna system of claim 1, wherein said first fractal antenna includes a region that defines a cut;

wherein said cut causes said antenna system to exhibit new and different frequencies of resonance.

6. The antenna system of claim 1, wherein said first fractal antenna is formed non-planarly such that frequencies of resonance for said antenna system are shifted.

7. The antenna system of claim 6, wherein said first fractal antenna is formed around a ferrite core.

8. The antenna system of claim 1, wherein a portion of said first fractal antenna is connected to a center conductor of a feedline, and wherein a ground conductor of said feedline is connected at least to a portion of said conductive element.

9. The antenna system of claim 4, wherein said conductive element is a second fractal antenna, wherein a portion of said first fractal antenna is connected to a center conductor of a feedline, and wherein a ground conductor of said feedline is connected to at least one region of said system defined by (a) a portion of said second fractal antenna, (b) a portion of said second fractal antenna and said conductive element, (c) said conductive element, and (d) said conductive element and a system ground.

10. The antenna system of claim 1, further including a ground plane member in sufficiently close proximity to said first fractal antenna to tune a characteristic of the resultant system.

11. The antenna system of claim 1, wherein a portion of said first fractal antenna is cutaway and removed to increase a resonant frequency of said system.

12. The antenna system of claim 1, wherein said first fractal antenna is undefined by an opening angle and has at least one element whose physical shape is defined substantially as a deterministic fractal of iteration $N \geq 2$ for at least a portion of said element.

13. The antenna system of claim 1, wherein said first fractal antenna includes a second element whose physical shape is defined substantially as a fractal of iteration $N' \geq 2$, where $(N-N') > \geq 0$.

15. The antenna system of claim 1, wherein said first fractal antenna is defined as a superposition over at least $N=2$ iterations of a fractal generator motif, an iteration being placement of said fractal generator motif upon a base figure through at least one positioning selected from the group consisting of (i) rotation, (ii) stretching, and (iii) translation.

16. The antenna system of claim 15, wherein said fractal generator motif has x-axis, y-axis coordinates for a next iteration N+1 defined by $x_{N+1} = f(x_N, y_N)$ and $y_{N+1} = g(x_N, y_N)$, where x_N, y_N are coordinates for iteration N, and where $f(x,y)$ and $g(x,y)$ are functions defining said fractal generator motif and behavior.

17. The antenna system of claim 15, wherein said fractal generator motif is selected from a family

consisting of (i) Koch, (ii) Minkowski, (iii) Cantor, (iv) torn square, (v) Mandelbrot, (vi) Caley tree, (vii) monkey's swing, (viii) Sierpinski gasket, and (ix) Julia.

18. The antenna system of claim 1, wherein said first fractal antenna has a perimeter compression parameter (PC) defined by:

$$PC = \frac{\textit{full-sized antenna element length}}{\textit{fractal-reduced antenna element length}}$$

where:

$$PC = A \cdot \log[N(D + C)]$$

in which A and C are constant coefficients for a given said fractal generator motif, N is an iteration number, and D is a fractal dimension given by log(L)/log(r), where L and r are one-dimensional antenna element lengths before and after fractalization, respectively.

19. A tunable fractal antenna system coupleable to a transceiver unit, the antenna comprising:

a first fractal antenna whose physical shape is defined substantially as a deterministic fractal of iteration $N \geq 2$ for at least a portion of said element, said antenna being undefined by an opening angle;

a conductive element, spaced-apart from said first fractal antenna by a distance Δ sufficiently small at a frequency of interest λ to decrease said at least one resonant frequency, to widen said bandwidth, or to cause a combination thereof;

wherein said conductive element is selected from the group consisting of (a) a planar conductor, (b) a second fractal antenna having a same said iteration N as said first fractal antenna, (c) a second fractal antenna having a same said iteration N as said first fractal antenna but having a different configuration, (d) a second fractal antenna having an iteration other than

said iteration N, (e) a second fractal antenna having an iteration other than said iteration N, but having a similar configuration, (f) a second fractal antenna angularly rotated relative to said first fractal antenna, and (g) a second fractal antenna defining a cut;

wherein said antenna system is tunable by varying at least one parameter selected from the group consisting of (a) said distance Δ, (b) relative rotation between said first and said second fractal antenna, (c) location at which a feedline center lead is coupled to said first fractal antenna, (d) location of a cut in said first fractal antenna, and (e) size of a region of said first fractal antenna cutaway and removed.

20. A method of tuning a fractal antenna and/or resonator system, comprising:

disposing a first fractal antenna a distance Δ from a conductive element;

tuning said system by modifying at least one parameter selected from a group consisting of (a) a magnitude of said distance Δ, (b) an angular orientation between said first fractal antenna and said conductive element, (c) an extent of curvature associated with at least one of said first fractal antenna and said conductive element, (d) a size of at least one of said first fractal antenna and said conductive element, (e) a shape of at least one of said first fractal antenna and said conductive element, (f) a location of said conductive element relative to said fractal antenna, (g) a presence of a cut defined in at least one of said first fractal antenna and said conductive element, and (g) a manner of coupling a feedline to at least one of said first fractal antenna and said conductive element.